Introduction to the Mathematics Standards and Key Content Shifts

"The essence of mathematics is not to make simple things complicated, but to make complicated things simple."

Stan Gudder

Agenda for Today

- Identify the advances and shifts in the 2010 Mathematics Standards
- Examine the architecture of the Mathematics Standards
- Identify rigor in standards and classroom instruction

Highlights of the Mathematics Standards

Key Advances in 2010 Mathematics Standards

Emphasis throughout on problem-solving, quantitative reasoning, and modeling

- **K-5:** Focus on number and operations
- **K-7:** Graded ramp up to algebra, through fractions, ratios, and proportional reasoning
- **6-8:** Rich hands-on work with ratios, geometry, statistics, and probability
- **High School:** Rigorous algebra, geometry, modeling, statistics and probability

Organization of Mathematics Standards

Standards for Mathematics Content

- K-8, presented by grade level with each grade level containing work on several domains.
- Domains often progress over several grade levels.
- 9-12, standards are arranged in *conceptual categories.*

8 Standards for Mathematical Practice

- Describe varieties of expertise “habits of mind” that mathematics educators at all levels should seek to develop in their students.
- Across all grade levels

Changes by Grade Bands: Grades K-5

- Numeration and operation intensified and introduced earlier
  - Early place value foundations in Kindergarten
  - Regrouping as composing/decomposing in Gr. 2
  - Decimals to hundredths in Gr. 4
- All 3 types of measurement introduced simultaneously (Non-standard, English, and Metric)
- Emphasis on fractions as numbers
- Emphasis on number line as visualization and structure

Changes by Grade Bands: Grades 6-8

- Ratio and proportion emphasized in Gr. 6
  - Ratio, unit rates, converting measurement, tables of values, graphing, missing value problems
- Percents introduced in Gr. 6
- Statistics introduced in Gr. 6
  - Statistic variability (measures of central tendency, distributions, interquartile range, mean and absolute deviation, data shape)
- Rational numbers in Gr. 7
- More rigorous algebraic understanding in Gr. 8

Changes by Grade Bands: Grades 6-8

- Much higher expectations at middle grades, where our capacity and student performance are weakest nationally

Changes by Grade Bands: Grades 9-12

- Supports both/either continuing an integrated approach or a traditional approach or new models that synthesize these two
- All students must master some topics traditionally from Algebra 2 or beyond
  - Simple periodic functions
  - Polynomials
  - Radicals
  - More probability and statistics
  - Introduction to mathematical modeling

Overview of the 2010 Mathematics Standards (Common Core State Standards)

The 2010 Mathematics Standards provide a consistent, clear understanding of what students are expected to learn, so teachers and parents know what they need to do to help them. The standards are focused, coherent, and relevant to the real world, describing the knowledge and skills that students need for success in college and careers.

In K-8 (Kindergarten, Elementary, and Middle School) each *grade* contains work on several *domains*, as described in the table below. For example: In Grade 1, the content includes Operations and Algebraic Thinking, Number and Operations in Base Ten, Measurement and Data, and Geometry.

Grade	K	1	2	3	4	5	6	7	8	HS Conceptual Categories
Domains	Counting & Cardinality						Ratios & Proportional Relationships		Functions	Functions
	Operations and Algebraic Thinking						Expression and Equations			Algebra
	Number and Operations in Base Ten						The Number System			Number & Quantity
				Fractions						
	Measurement and Data						Statistics and Probability			Statistics & Probability
	Geometry						Geometry			Geometry

In High School, the standards are arranged in *conceptual categories*, such as Algebra or Functions. In each conceptual category there are *domains*, such as Creating Equations and Interpreting Functions.

Conceptual Category	Number & Quantity	Algebra	Functions	Geometry	Statistics & Probability
Domains	The Real Number System	Seeing Structure in Expressions	Interpreting Functions	Congruence	Interpreting Categorical & Quantitative Data
	Quantities	Arithmetic with Polynomials & Rational Expressions	Building Functions	Similarity, Right Triangles, & Trigonometry	Making Inferences & Justifying Conclusions
	The Complex Number System	Creating Equations	Linear, Quadratic, & Exponential Models	Expressing Geometric Properties with Equations	Conditional Probability & the Rules of Probability
	Vector & Matrix Quantities	Reasoning with Equations & Inequalitites	Trigonometric Functions	Geometric Measurement & Dimension	Using Probability to Make Decisions

Shifts in the Mathematics Standards

If we just swap out the old standards and put the new CCSS in the old boxes

- into old systems and procedures
- into the old relationships
- into old instructional materials and formats
- into old assessment tools,

Then nothing will change

Key Shifts in Mathematics Standards

Shift 1
FOCUS

- **Focus** strongly where the standards focus
- **Narrow** and **deepen** the work of each grade level
- **Switch** to a curriculum that is a mile deep and an inch wide so that students gain strong foundations

The Importance of **Focus**

- TIMSS and other international comparisons suggest that the U.S. curriculum is ‘a mile wide and an inch deep.’
- “On average, the U.S. curriculum omits only 17% of the TIMSS grade 4 topics compared with an average omission rate of 40% for the 11 comparison countries.
- U.S. covers all but 2% of the TIMSS topics through grade 8 compared with a 25% non-coverage rate in the other countries.
- High-scoring Hong Kong’s curriculum omits 48% of the TIMSS items through grade 4, and 18% through grade 8.
- Less topic coverage can be associated with higher scores on those topics covered because students have more time to master the content that is taught.

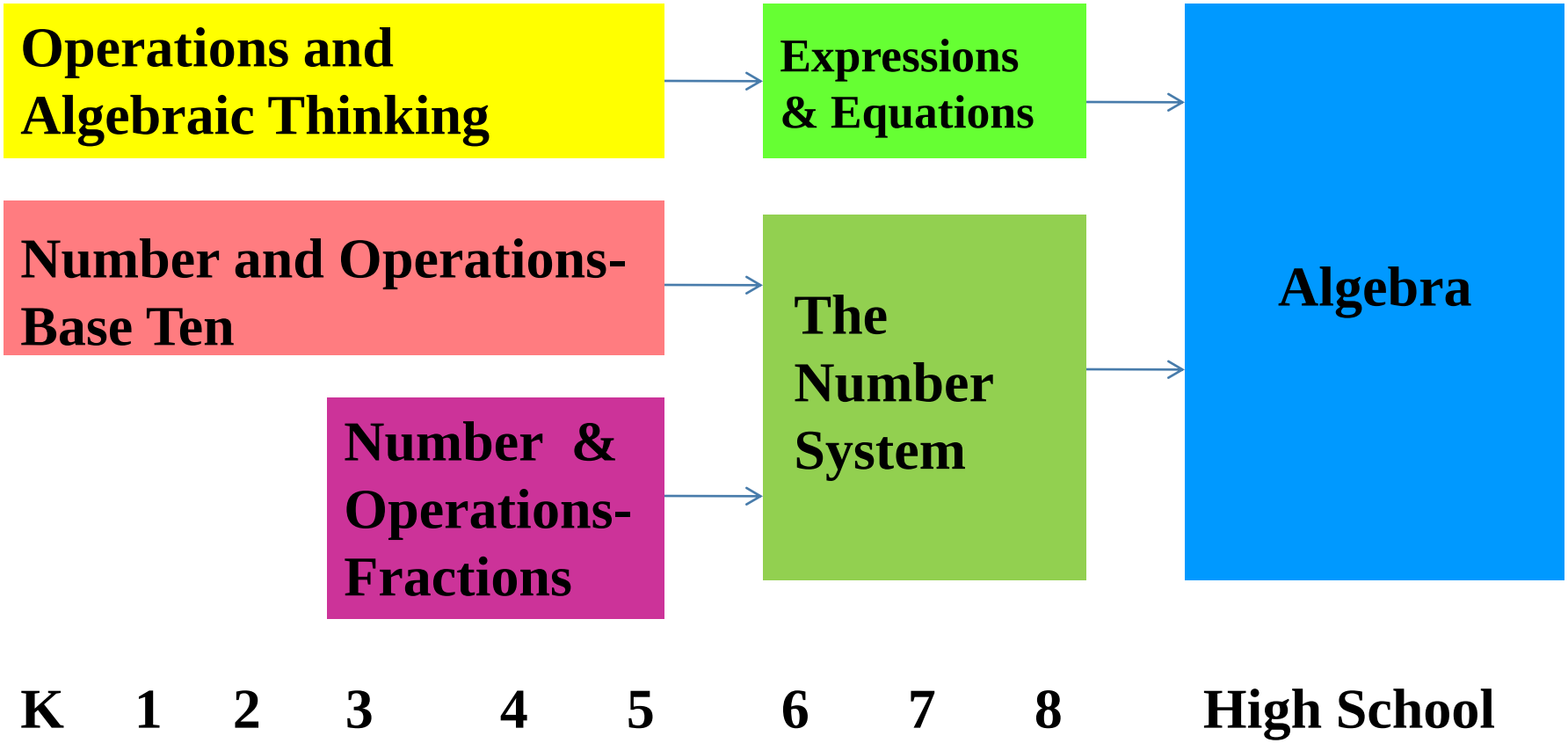
Key Shifts in Mathematics Standards

Shift 2

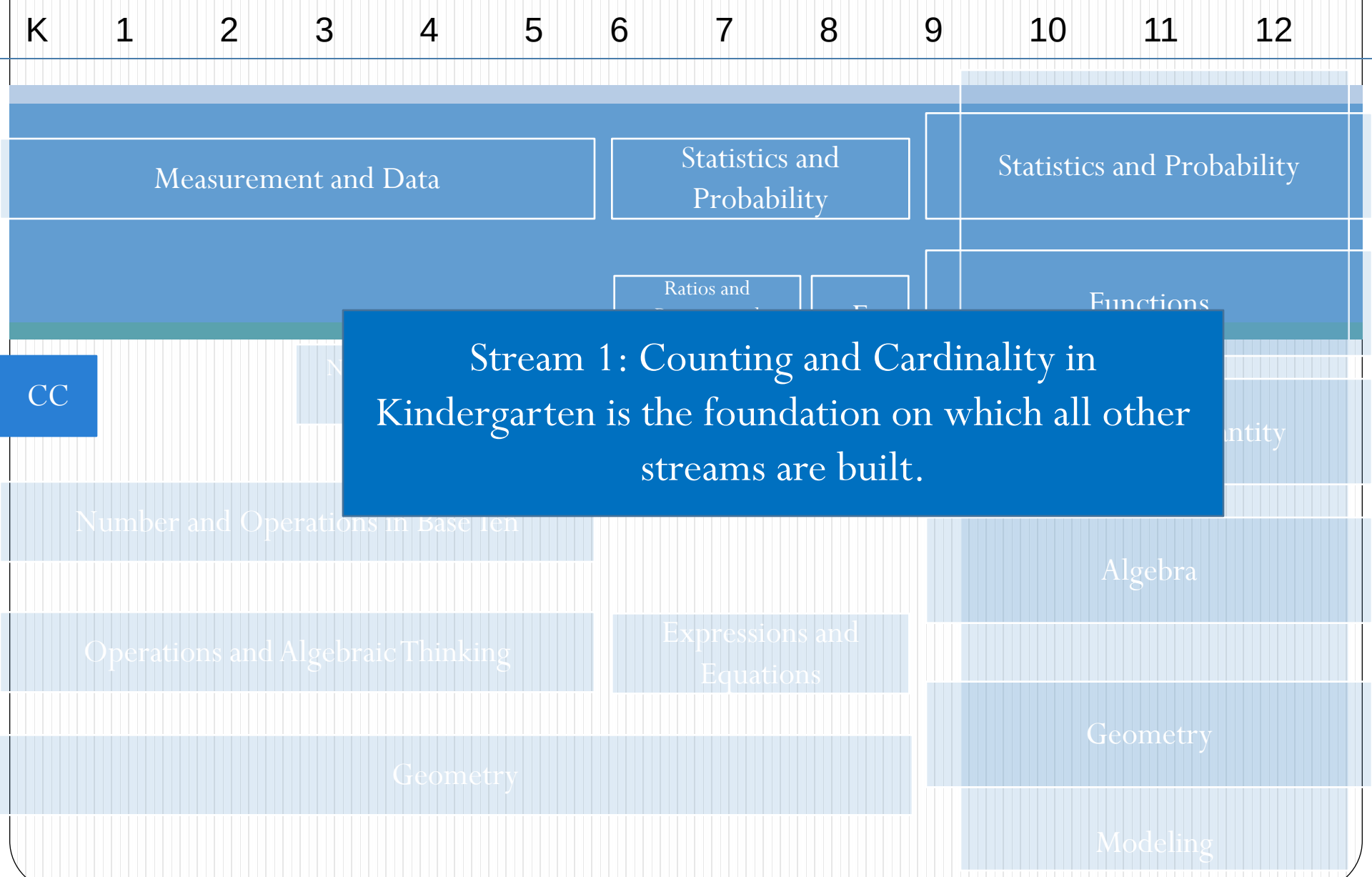
COHERENCE

- **Connect** major topics within grades and across grades
- **Build** new understanding onto foundations built in previous years

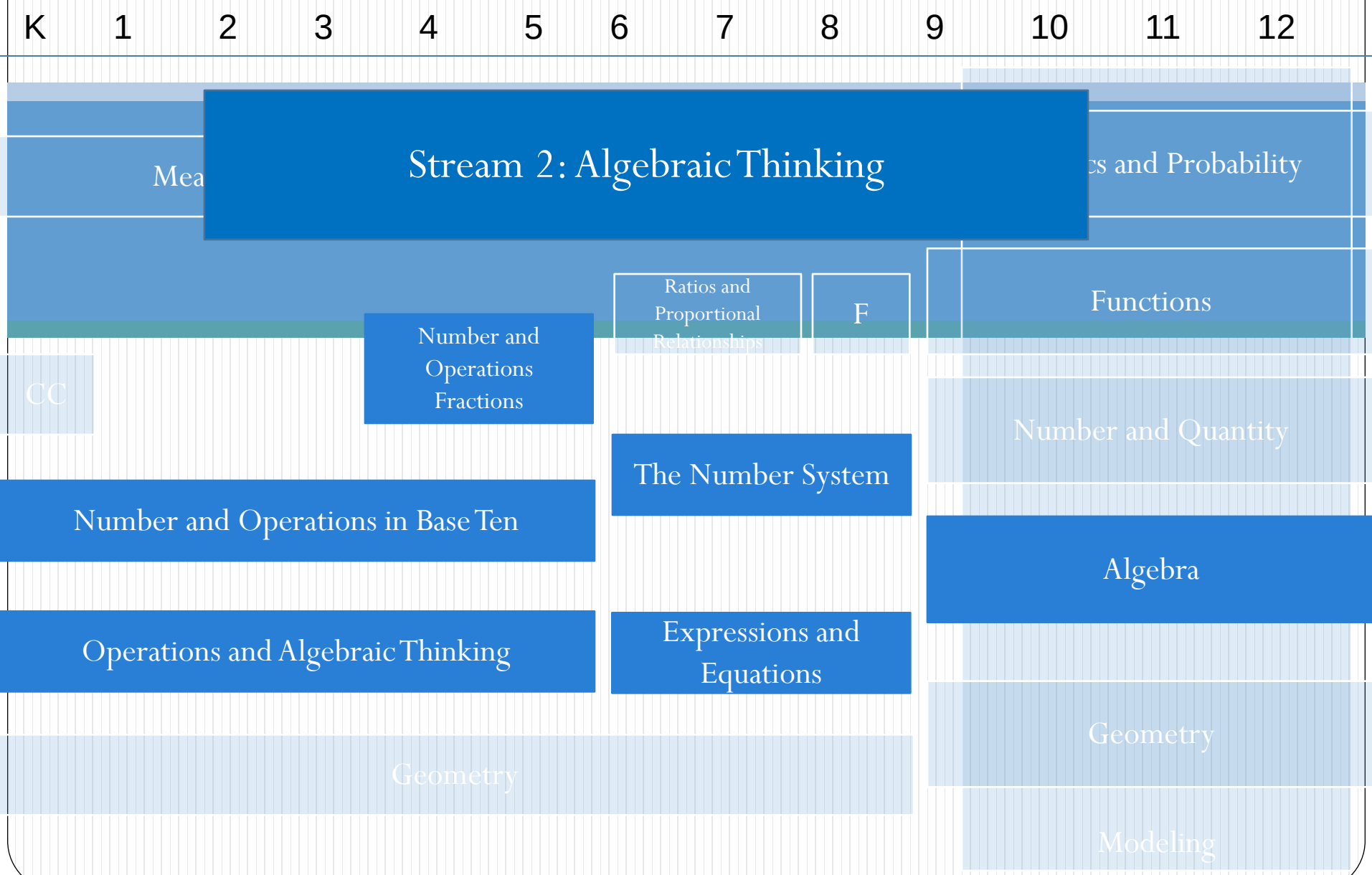
Flow Within and Across Grade Levels



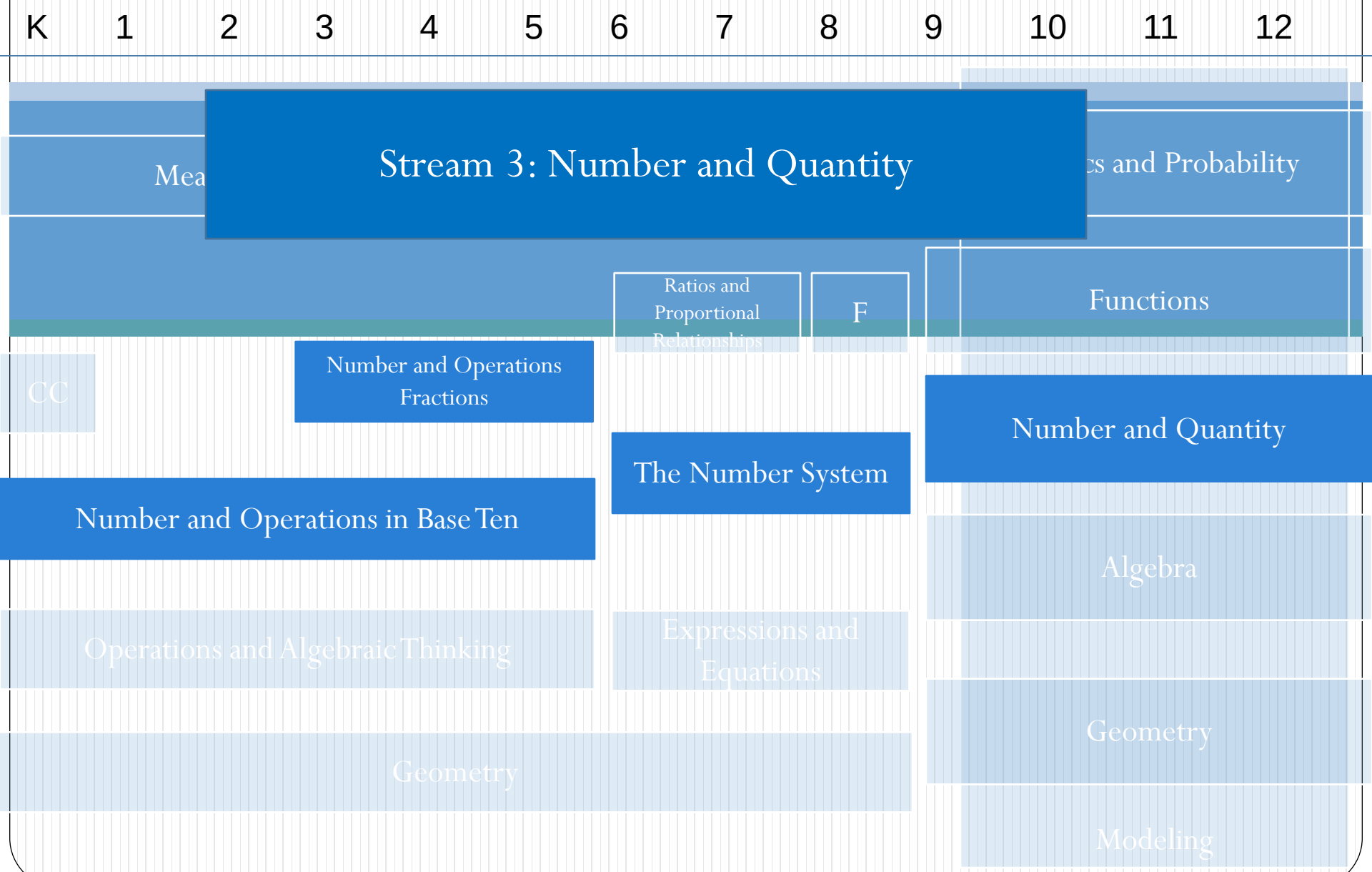
K-12 Mathematics Streams



K-12 Mathematics Streams



K-12 Mathematics Streams



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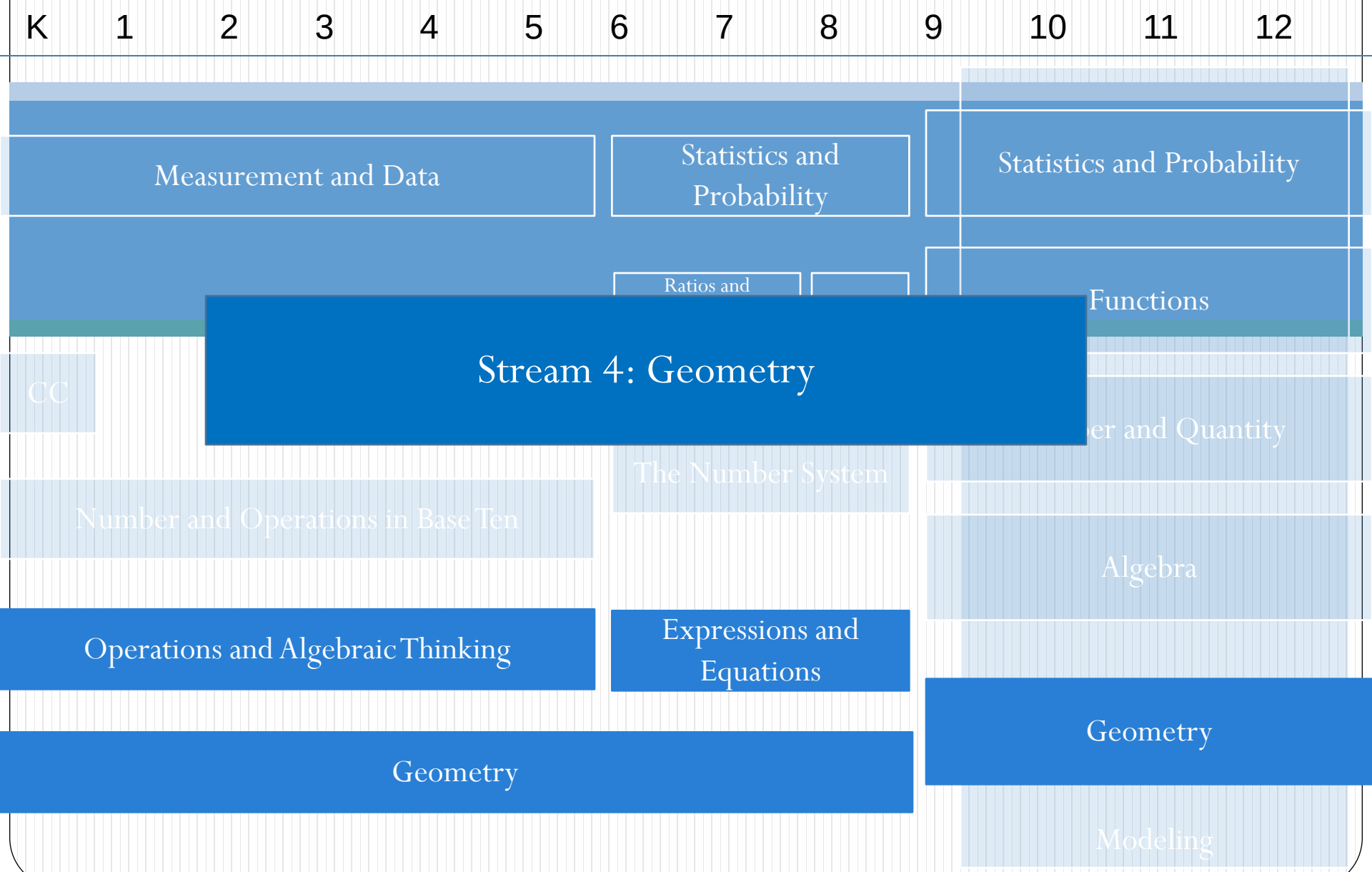

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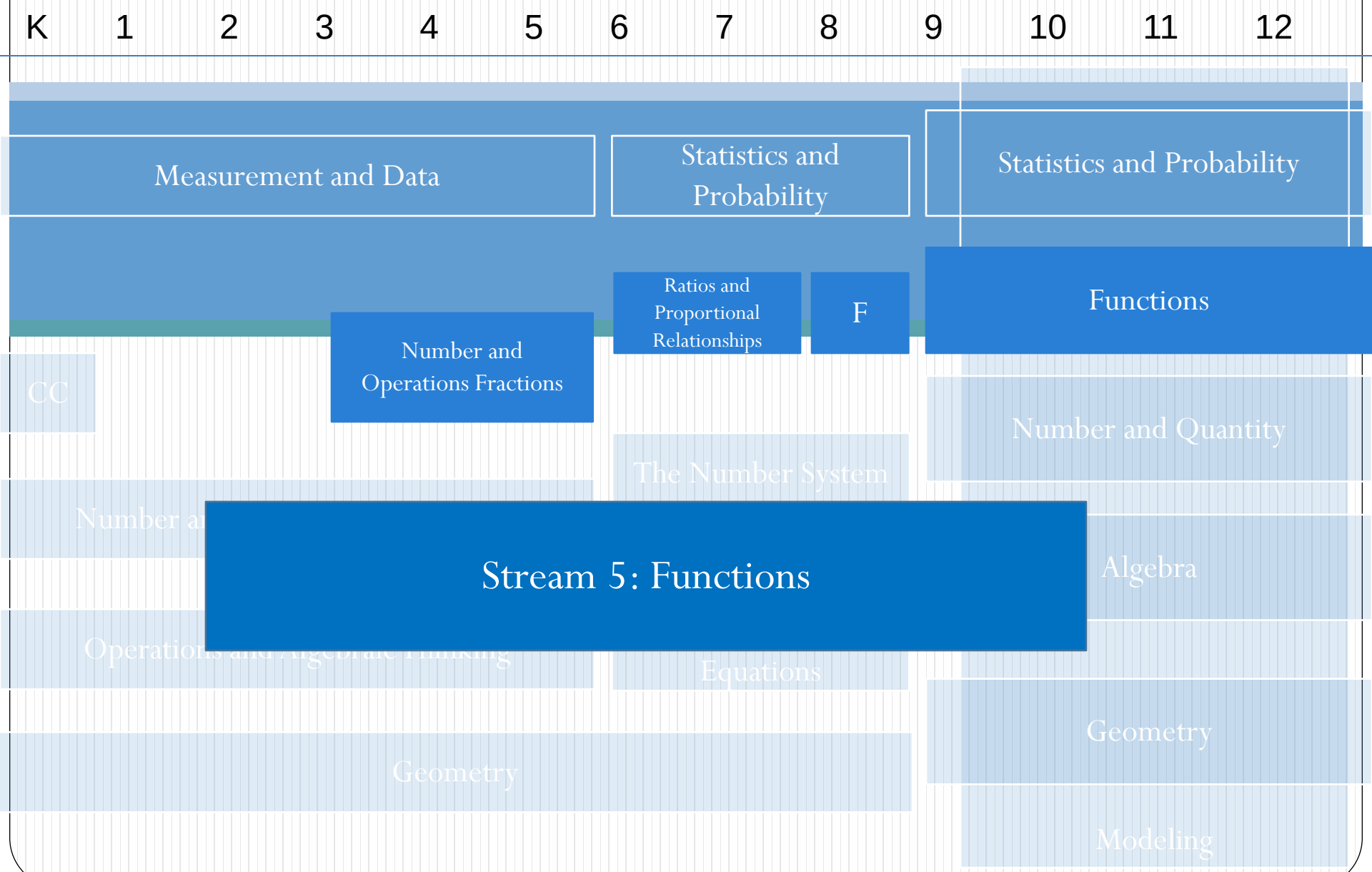
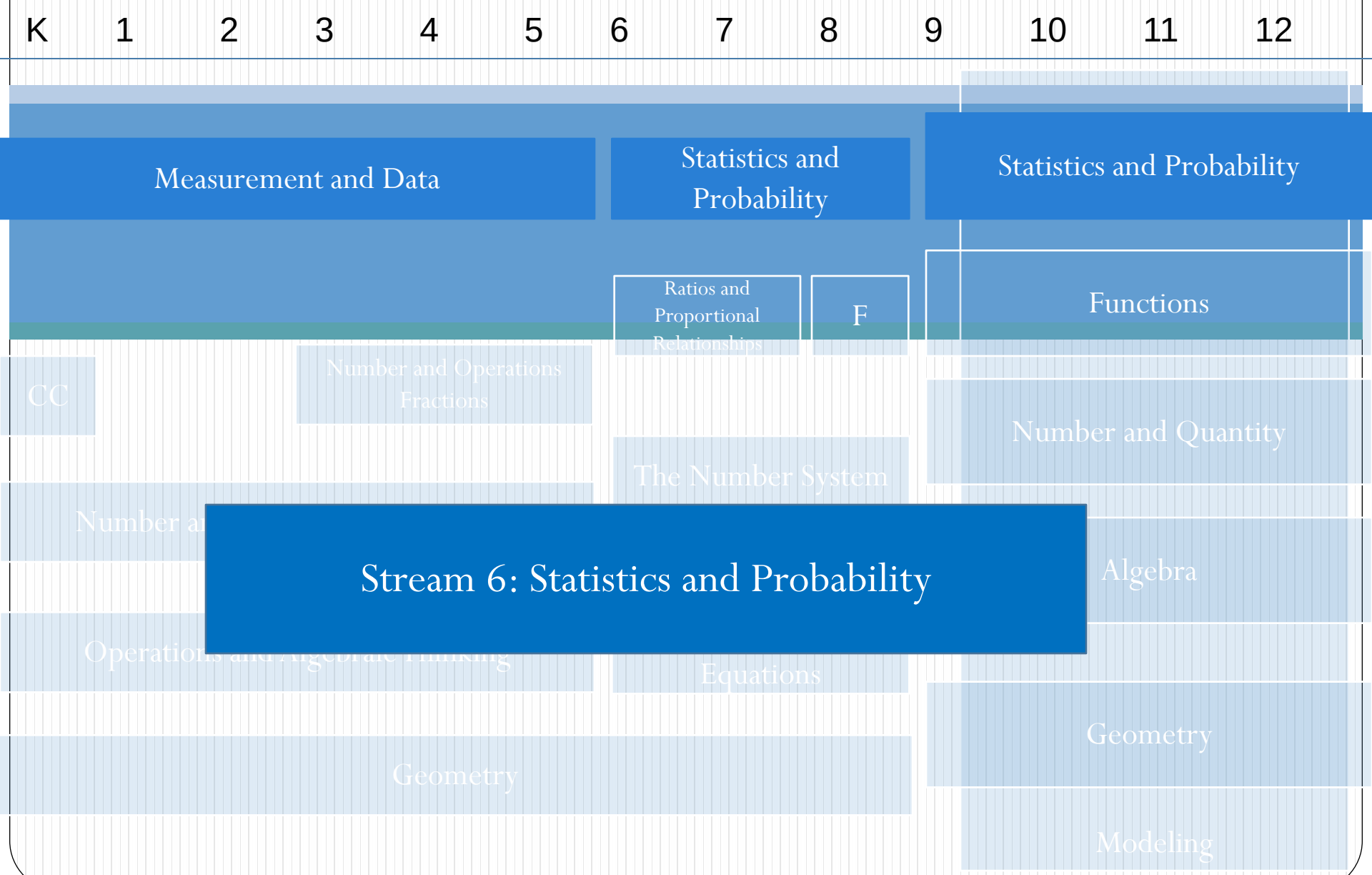
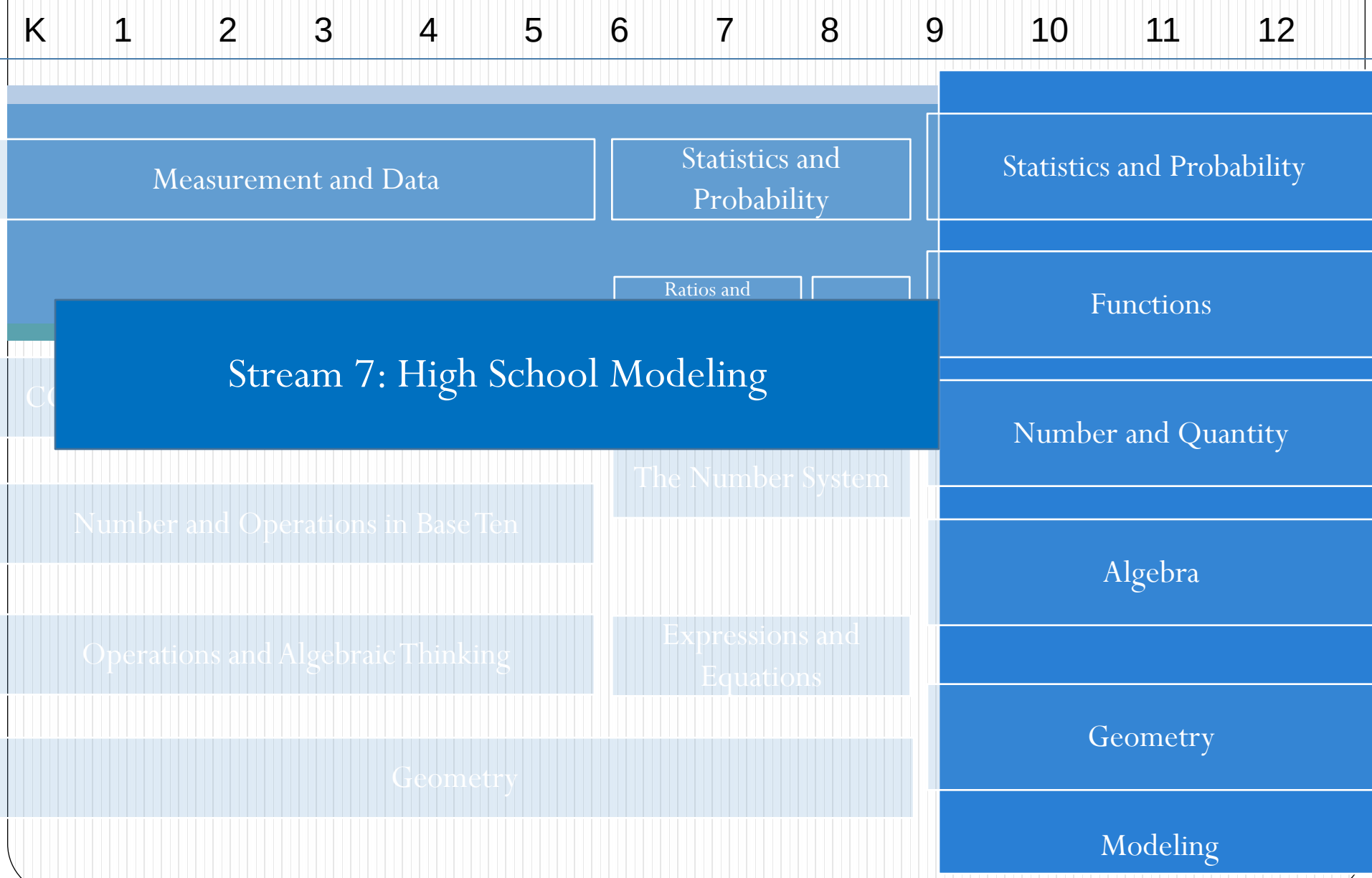


K-12 Mathematics Streams



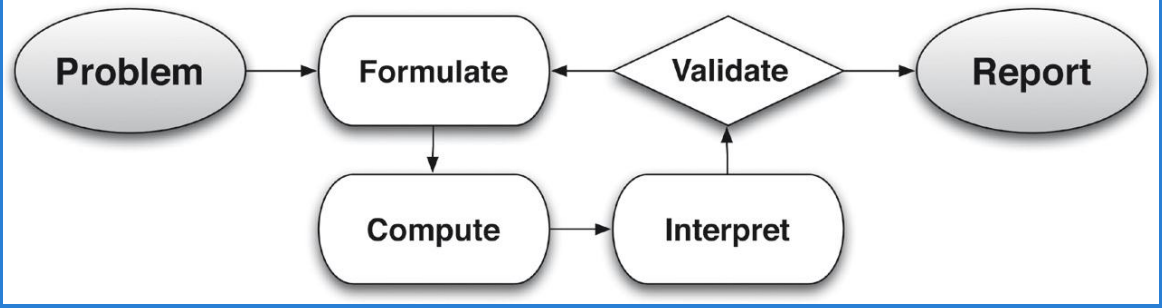
K-12 Mathematics Streams



K-12 Mathematics Streams

K 1 2 3 4 5 6 7 8 9 10 11 12

Modeling (9 – 12)



Modeling is best interpreted not as a collection of isolated topics but rather in relation to other standards. Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by a star symbol (★).

Statistics and Probability

Functions

Number and Quantity

Algebra

Geometry

Modeling

Key Shifts in Mathematics Standards

Shift 3

RIGOR

- **Pursue** conceptual understanding, procedural skill and fluency, and application with **equal intensity**
- **Emphasize** conceptual understanding of key concepts
- **Support** speed and accuracy in calculation
- **Use** mathematics flexibly for application

How do these two fraction items differ?

I. 4/5 is closer to 1 than 5/4. Show why this is true on a number line.

II. Which is closer to 1?

a) 5/4
b) 4/5
c) ¾
d) 7/10

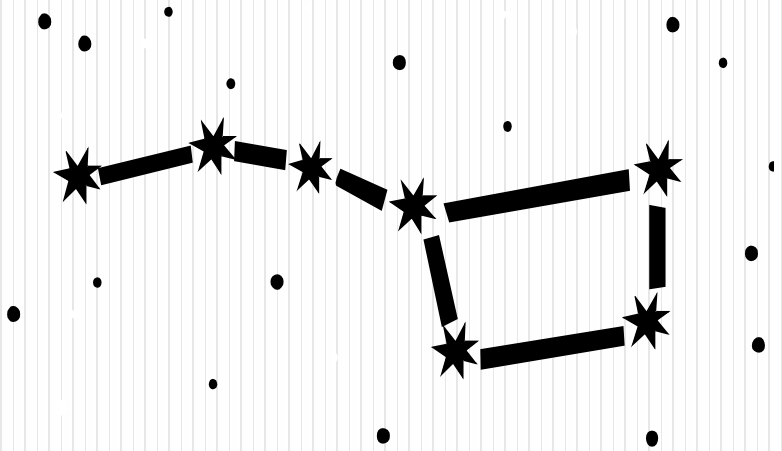
Think about ***how these items differ***.
What do they demand from students?

Agenda for Today

- Identify the advances and shifts in the 2010 Mathematics Standards
- Examine the architecture of the Mathematics Standards
- Identify rigor in the standards and classroom instruction

The Architecture of Grade Level Documents

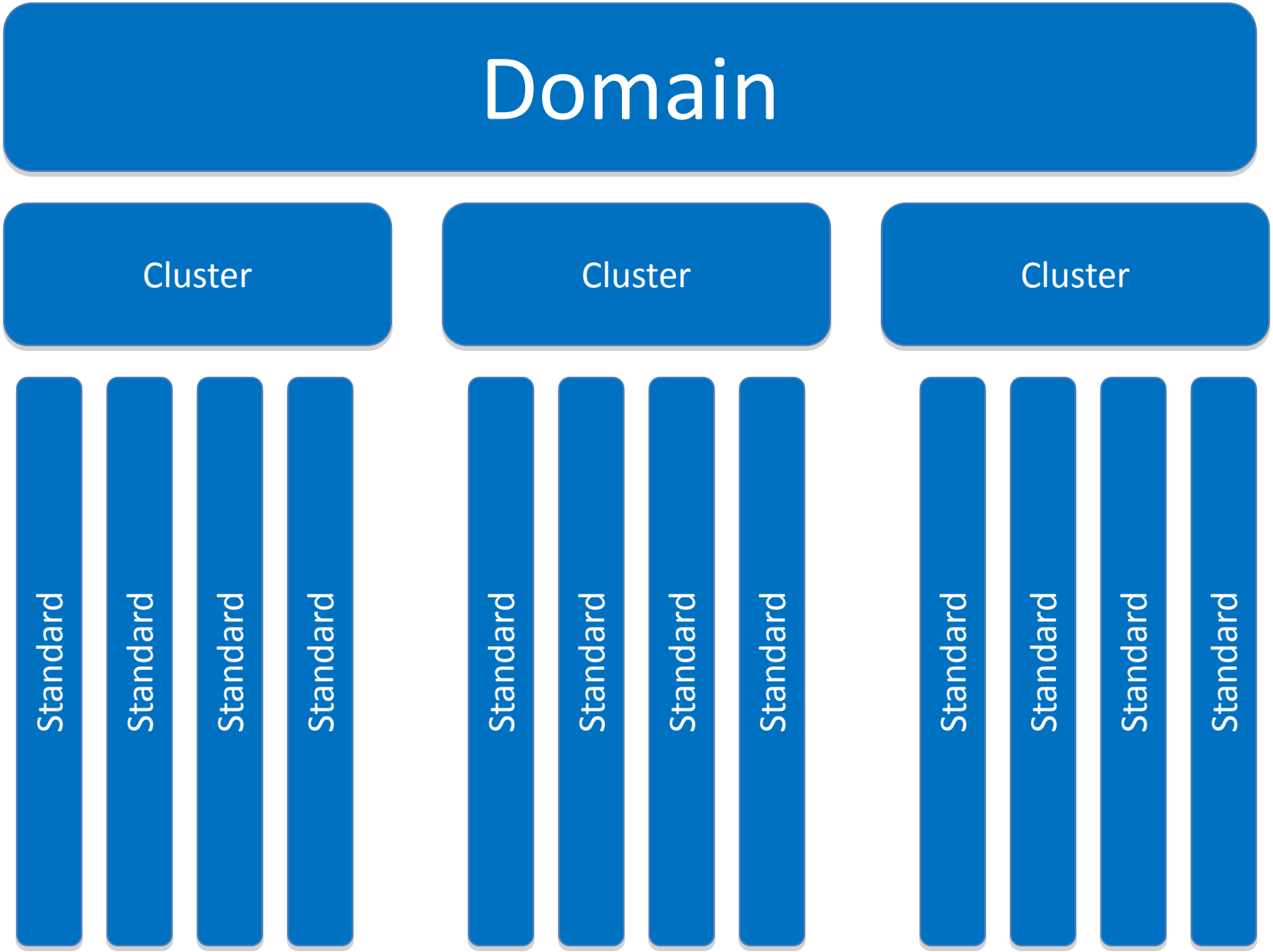
Overview, Critical Ideas, Standards



Download documents at:

http://www.azed.gov/standards-practices/mathematics-standards/

Grades K-8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Grade 4
Grade 4 Overview

Operations and Algebraic Thinking (OA)

- Use the four operations with whole numbers to solve problems.
- Gain familiarity with factors an
- Generate and analyze patterns.

Number and Operations in Base Ten (NBT)

- Generalize place value understanding for multidigit whole numbers.
- Use place value understan of operations to perform mul

Number and Operations—Fr

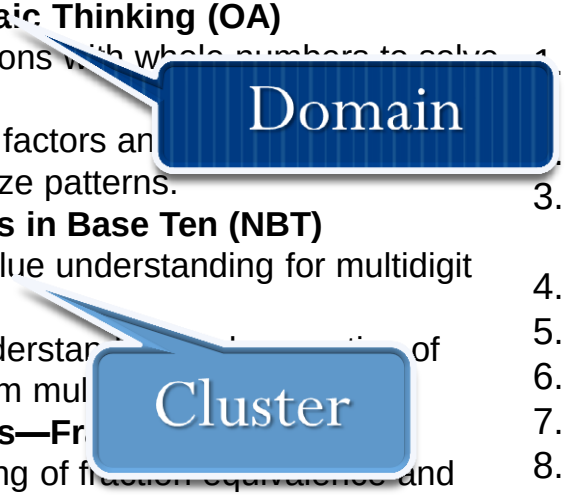
- Extend understanding of fraction equivalence and ordering.
- Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.
- Understand decimal notation for fractions, and compare decimal fractions.

Measurement and Data (MD)

- Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.
- Represent and interpret data.
- Geometric measurement: understand concepts of angle and measure angles.

Geometry (G)

- Draw and identify lines and angles, and classify shapes by properties of their lines and angles.



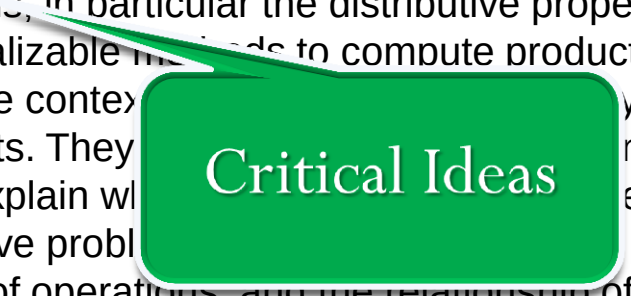
Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Grade 4

In Grade 4, instructional time should focus on three critical areas: (1) developing understanding and fluency with multi-digit multiplication, and developing understanding of dividing to find quotients involving multi-digit dividends; (2) developing an understanding of fraction equivalence, addition and subtraction of fractions with like denominators, and multiplication of fractions by whole numbers; (3) understanding that geometric figures can be analyzed and classified based on their properties, such as having parallel sides, perpendicular sides, particular angle measures, and symmetry.

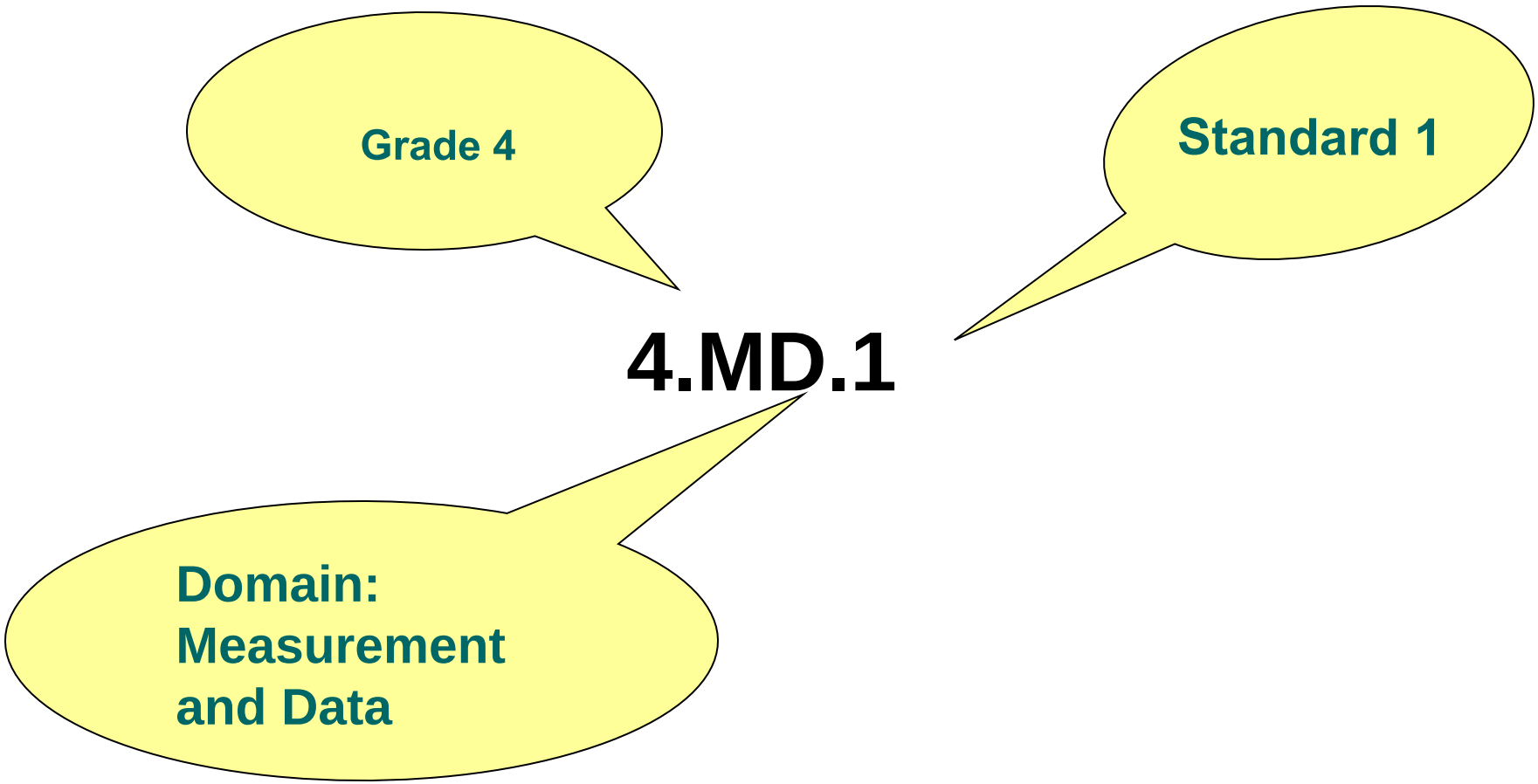
(1) Students generalize their understanding of place value to 1,000,000, understanding the relative sizes of numbers in each place. They apply their understanding of models for multiplication (equal-sized groups, arrays, area models), place value, and properties of operations, in particular the distributive property, as they develop, discuss, and use efficient, accurate, and generalizable methods to compute products of multi-digit whole numbers. Depending on the numbers and the context, they select and accurately apply appropriate methods to estimate or mentally calculate products. They develop fluency with efficient procedures for multiplying whole numbers; understand and explain why the procedures based on place value and properties of operations; and use them to solve problems. They apply their understanding of models for division, place value, properties of operations, and the relationship of division to multiplication as they develop, discuss, and use efficient, accurate, and generalizable procedures to find quotients involving multi-digit dividends. They select and accurately apply appropriate methods to estimate and mentally calculate quotients, and interpret remainders based upon the context.



(2) Students develop understanding of fraction equivalence and operations with fractions. They recognize that two different fractions can be equal (e.g., 15/9 = 5/3), and they develop methods for generating and recognizing equivalent fractions. Students extend previous understandings about how fractions are built from unit fractions, composing fractions from unit fractions, decomposing fractions into unit fractions, and using the meaning of fractions and the meaning of multiplication to multiply a fraction by a whole number.

(3) Students describe, analyze, compare, and classify two-dimensional shapes. Through building, drawing, and analyzing two-dimensional shapes, students deepen their understanding of properties of two-dimensional objects and the use of them to solve problems involving symmetry.

Coding for K-8 Mathematics Standard

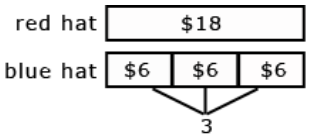


Operations and Algebraic Thinking (OA)

Use the four operations with whole numbers to [illegible]

Domain

Cluster

Standards	***[illegible]ntical Pra***	***Examples***
Students are expect		
4.OA.1. Interpret a r[illegible] equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. Connections: 4.OA.3; 4.SL.1d; ET04-S1C2-01; ET04-S1C2-02	[illegible]eason abstractly and quantitatively. 4.MP.4. Model with mathematics.	A *multiplicative comparison* is a situation in which one quantity is multiplied by a specified number to get another quantity (e.g., "*a* is *n* times as much as *b*"). Students should be able to identify and verbalize which quantity is being multiplied and which number tells how many times.
4.OA.2. Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive co[illegible]parison. (see Table 2) Connections: 4.RI.7; ET04-S1C2[illegible] ET04-S1C2-02	4.MP.2. Reason abstractly and quantitatively. 4.MP.4. Model with mathematics. 4.MP.5. Use appropriate tools strategically. 4.MP.7. Look for and make [illegible] of structure	Students need many opportunities to solve contextual problems. Table 2 in the glossary includes the following multiplication problem: "A blue hat costs $6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost?"  In solving this problem, the student should identify $6 as the quantity that is being multiplied by 3. The student should write the problem using a symbol to represent the unknown. ($6 x 3 = ☐) Table 2 in the glossary includes the following division problem: A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue hat? In solving this problem, the student should identify $18 as the quantity being divided into shares of $6. Continued on next page

Standard

Operations and Algebraic Thinking (OA)

Use the four operations with whole numbers to solve problems.

Standards	***Mathematical Practices***	***Explanations and Examples***
Students are expected to:		
4.OA.1. Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. Connections: 4.OA.3; 4.SL.1d; ET04-S1C2-01; ET04-S1C2-02	4.MP.2. Reason abstractly and quantitatively. 4.MP.4. Model with mathematics.	A *multiplicative comparison* is a situation in which one quantity is multiplied by a specified number to get another quantity (e.g., "*a* is *n* times as much as *b*"). Students should be able to identify and verbalize which quantity is being multiplied and which number tells how many times.
4.OA.2. Multiply or … problems involving … comparison, e.g., b… equations with a sy… unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison. (see Table 2) Connections: 4.RI.7; E… ET04-S1C2-02	…n abstractly …ely. …with 4.MP.5. Use appropriate tools strategically. 4.MP.7. Look for and mak… use of structure.	Students need many opportunities to solve contextual problems. Table 2 in the glossary includes the following multiplication problem: "A blu… hat costs $6. A red hat costs 3 times as much as the blu… Ho… In solving this problem, the student should identify $6 as the quantity that is being multiplied by 3. The student should write the problem using a symbol to represent the unknown. ($6 x 3 = ☐) Table 2 in the glossary includes the following division problem: A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue hat? In solving this problem, the student should identify $18 as the quantity being divided into shares of $6. Continued on next page

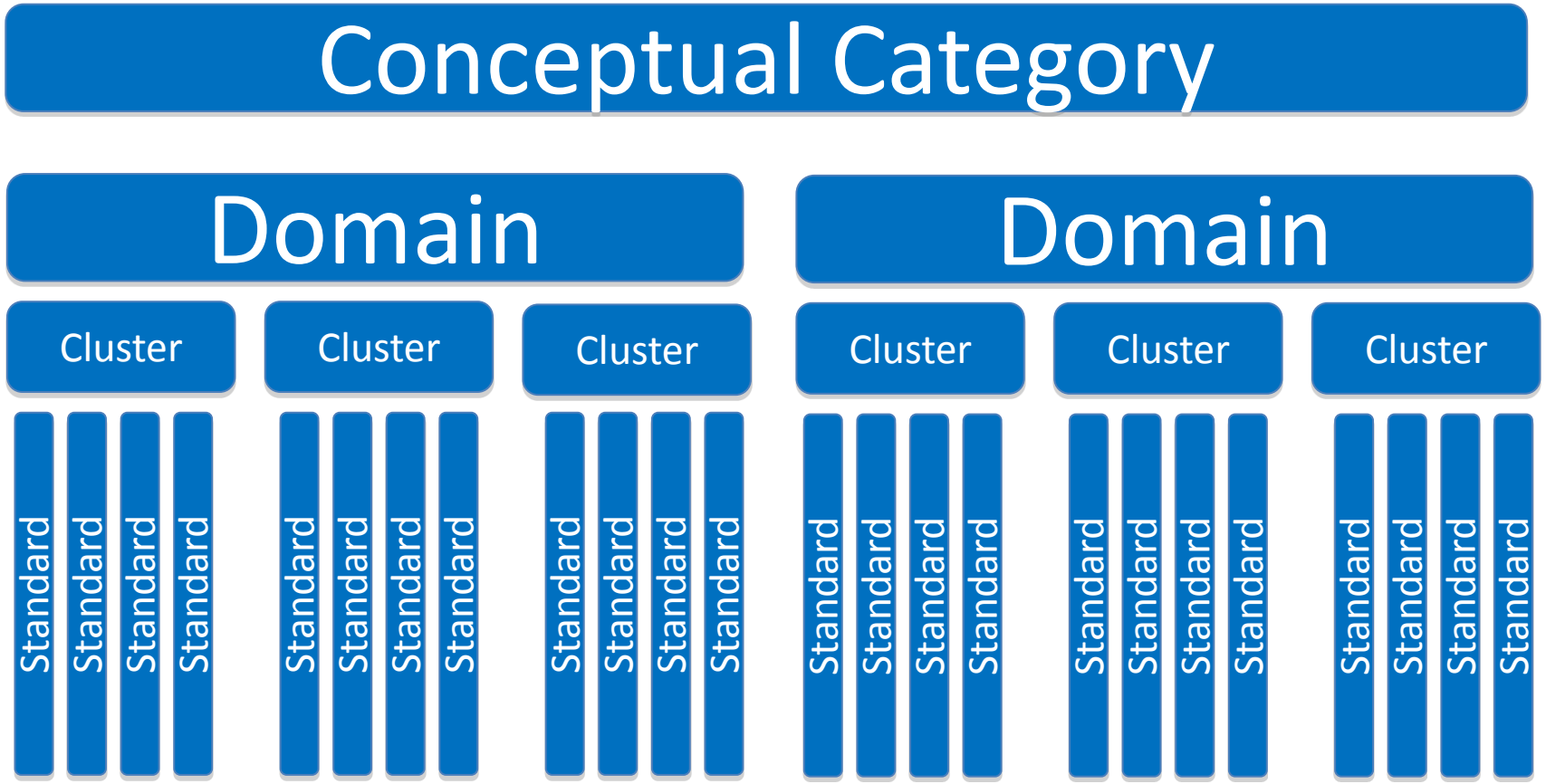
Explanations & Examples

Connections

Mathematical Practices

Standard

High School


Conceptual Category
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High School (9-12)

The high school standards specify the mathematics that all students should study in order to be college and career ready. Additional mathematics that students should learn in fourth credit courses or advanced courses such as calculus, advanced statistics, or discrete mathematics is indicated by (+). All standards without a (+) symbol should be in the common mathematics curriculum for all college and career ready students. Standards with a (+) symbol may also appear in courses intended for all students.

The high school standards are listed in conceptual categories including Number and Quantity, Algebra, Functions, Modeling, Geometry, Statistics and Probability, and Contemporary Mathematics. Conceptual categories portray a coherent view of high school mathematics; a student's work with functions, for example, cr rse boundaries, potentially up through and including calculus. Modeling is best interpreted not as a c relation to other standards. Making mathematical models is a Standard for Mathematical Practic s appear throughout the high school standards indicated by a star symbol (★).

Conceptual Category

High School - Number and Quantity Overview

The Real Number System

- Extend the properties of exponents to rational exponents
- Use properties of rational

Domain

Quantities

- Reason quantitatively and use units to solve problems

The Complex Number System

- Perform arithmetic operations with complex numbers
- Represent complex numbers and their operations on the complex plane
- Use complex numbers in polynomial identities and

Cluster

Vector and Matrix Quantities

- Represent and model with vector quantities.
- Perform operations on vectors.
- Perform operations on matrices and use matrices in applications.

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.

for and make use of structure.

for and express regularity in repeated reasoning.

High School (9-12)

High School - Numbers and Quantity

Numbers and Number Systems. During the years from kindergarten to eighth grade, students must repeatedly extend their conception of number. At first, "number" means "counting number": 1, 2, 3…. Soon after that, 0 is used to represent "none" and the whole numbers are formed by the counting numbers together with zero. The next extension is fractions. At first, fractions are barely numbers and tied strongly to pictorial representations. Yet by the time students understand division of fractions, they have a strong concept of fractions as numbers and have connected them, via their decimal representations, with the base-ten system used to represent the whole numbers. During middle school, fractions are augmented by negative fractions to form the rational numbers. In Grade 8, students extend this system once more, augmenting the rational numbers with the irrational numbers to form the real numbers. In high school, students will be exposed to yet another extension of number, when the real numbers are augmented by the imaginary numbers to form the complex numbers.

With each extension of number, the meanings of addition, subtraction, multiplication, an ew number system—integers, rational numbers, real numbers, and complex numbers—the four op rtant ways: They have the commutative, associative, and distributive properties and their new mea ious meanings.

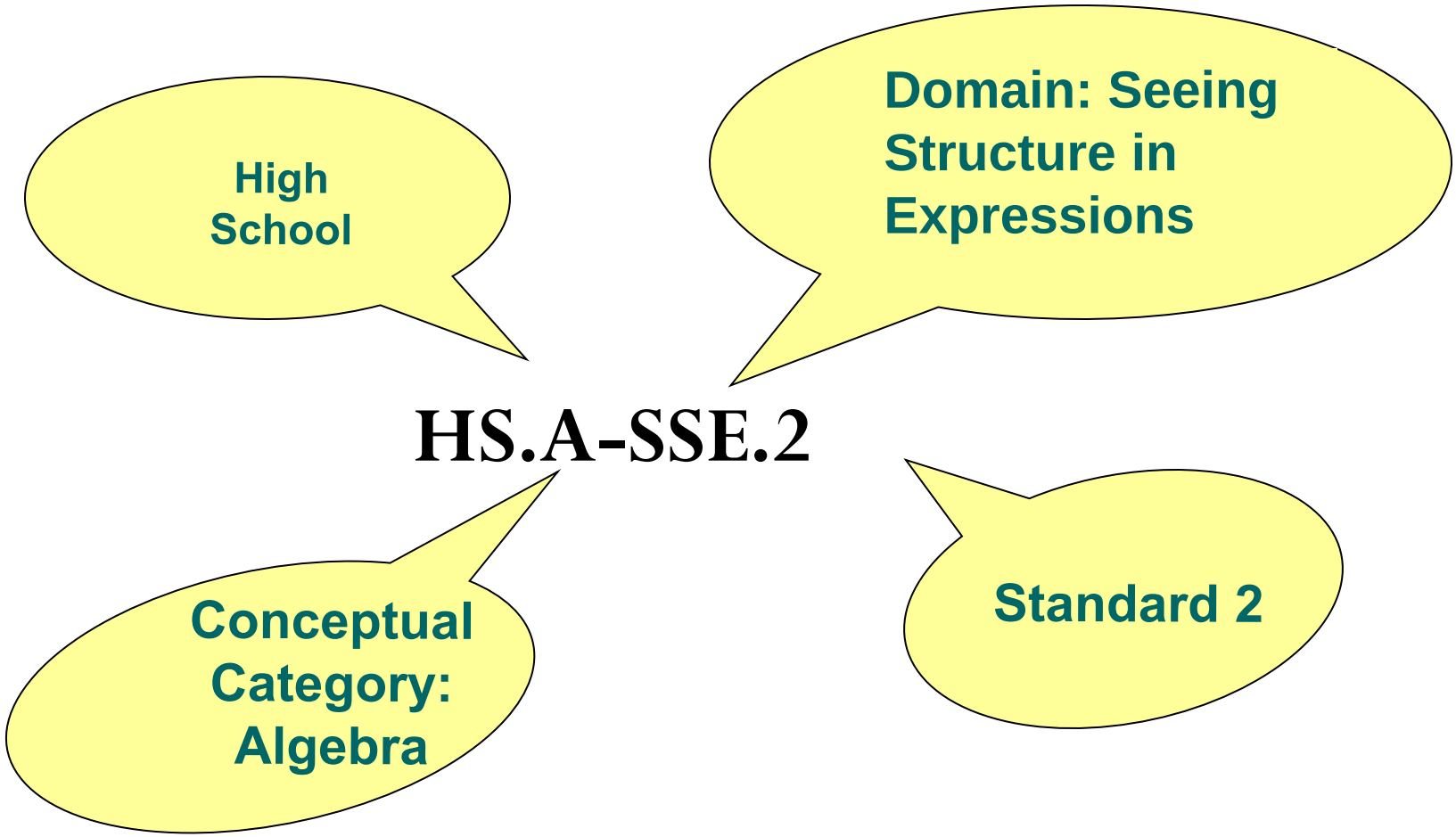
Critical Ideas By Domain

Extending the properties of whole-number exponents leads to new and productive nota ole-number exponents suggest that $(5^{1/3})^3$ should be $5^{(1/3)\cdot 3} = 5^1 = 5$ and that $5^{1/3}$ should be the cube

Calculators, spreadsheets, and computer algebra systems can provide ways for students to become better acquainted with these new number systems and their notation. They can be used to generate data for numerical experiments, to help understand the workings of matrix, vector, and complex number algebra, and to experiment with non-integer exponents.

Quantities. In real world problems, the answers are usually not numbers but quantities: numbers with units, which involves measurement. In their work in measurement up through Grade 8, students primarily measure commonly used attributes such as length, area, and volume. In high school, students encounter a wider variety of units in modeling, e.g., acceleration, currency conversions, derived quantities such as person-hours and heating degree days, social science rates such as per-capita income, and rates in everyday life such as points scored per game or batting averages. They also encounter novel situations in which they themselves must conceive the attributes of interest. For example, to find a good measure of overall highway safety, they might propose measures such as fatalities per year, fatalities per year per driver, or fatalities per vehicle-mile traveled. Such a conceptual process is sometimes called quantification. Quantification is important for science, as when surface area suddenly "stands out" as an important variable in evaporation. Quantification is also important for companies, which must conceptualize relevant attributes and create or choose suitable measures for them.

Coding for High School Mathematics Standards



Number and Quantity: The Real Number System – (N-RN)

Extend the properties of exponents to rational exponents.

Standards	***Label***	***Mathematical Practices***	***and Examples***
Student[s] expected to:			
HS[.] of t[he] foll[owing] inte[nded] allo[w] in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*		MP.2. Reason abstractly and quantitatively.	
HS.N-RN.2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.	❖	HS.MP.7. Look for and make use of structure.	Examples: $\sqrt[3]{5^2} = 5^{\frac{2}{3}}; 5^{\frac{2}{3}} = \sqrt[3]{5^2}$ •Rewrite using fractional exponents: $\sqrt[5]{16} = \sqrt[5]{2^4} = 2^{\frac{4}{5}}$ •Rewrite $\frac{\sqrt{x}}{x^2}$ in at least three alternate forms. Solution: $x^{-\frac{3}{2}} = \frac{1}{x^{\frac{3}{2}}} = \frac{1}{\sqrt{x^3}} = \frac{1}{x\sqrt{x}}$ •Rewrite $\sqrt[4]{2^{-4}}$ using only fractional exponents. •Rewrite $\sqrt[3]{x^3+3x^2+3x+1}$ in simplest form.

Conceptual Category

Domain

Cluster

Standard

Key to Labels:

9-10 = Standards for Grades 9 and 10
+ = 4th Credit Standards

❖ = Algebra 2 Standards
★ = Standards connected to Mathematical Modeling

Number and Quantity: The Real Number System – (N-RN)

Extend the properties of exponents to rational exponents.

Standards	***Label***	***Mathematical Practices***	***Explanations and Examples***
Students are expected to:			
HS.N-RN.1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*	❖	HS.MP.2. Reason abstractly and quantitatively.	
HS.N-RN.2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.	❖	HS.MP.7. Look for and make use of structure.	Examples: $\sqrt[3]{5^2} = 5^{\frac{2}{3}}; 5^{\frac{2}{3}} = \sqrt[3]{5^2}$ • Rewrite using fractional exponents: $\sqrt[5]{16} = \sqrt[5]{2^4} = 2^{\frac{4}{5}}$ • Rewri… $\sqrt{x}$ … in at least three alternate forms. Solu… $x^{-\frac{3}{2}} = \frac{1}{x^{\frac{3}{2}}} = \frac{1}{\sqrt{x^3}} = \frac{1}{x\sqrt{x}}$ • Rewrite $\sqrt{2^{-}}$ …ing only fractional exponents. • Rew… … form.

Mathematical Practices

Label

Standard

Explanations & Examples

Key to Labels:

9-10 = Standards for Grades 9 and 10 ❖ = Algebra 2 Standards

+ = 4th Credit Standards ★ = Standards connected to Mathematical Modeling

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Mathematical Practices

The Standards for Mathematical Practice describe characteristics and traits that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy). These eight practices can be clustered into the following categories as shown in the chart below: *Habits of Mind of a Productive Mathematical Thinker, Reasoning and Explaining, Modeling and Using Tools, and Seeing Structure and Generalizing.*

Habits of Mind of a Productive Mathematical Thinker MP.1 Make sense of problems and persevere in solving them. MP.6 Attend to precision.	***Reasoning and Explaining*** MP. 2 Reason abstractly and quantitatively. MP. 3 Construct viable arguments and critique the reasoning of others.
	Modeling and Using Tools MP. 4 Model with mathematics. MP. 5 Use appropriate tools strategically.
	Seeing Structure and Generalizing MP. 7 Look for and make use of structure. MP. 8 Look for and express regularity in repeated reasoning.

Standards for Mathematical Practice		
Standards		***Explanations and Examples***
Students are expected to:	Mathematical Practices are listed throughout the grade level document in the 2nd column to reflect the need to connect the mathematical practices to mathematical content in instruction.	
4.MP.1. Make sense of problems and persevere in solving them.		In fourth grade, students know that doing mathematics involves solving problems and discussing how they solved them. Students explain to themselves the meaning of a problem and look for ways to solve it. Fourth graders may use concrete objects or pictures to help them conceptualize and solve problems. They may check their thinking by asking themselves, “Does this make sense?” They listen to the strategies of others and will try different approaches. They often will use another method to check their answers.
4.MP.2. Reason abstractly and quantitatively.		Fourth graders should recognize that a number represents a specific quantity. They connect the quantity to written symbols and create a logical representation of the problem at hand, considering both the appropriate units involved and the meaning of quantities. They extend this understanding from whole numbers to their work with fractions and decimals. Students write simple expressions then record calculations with numbers and represent or round numbers using place value concepts.
4.MP.3. Construct viable arguments and critique the reasoning of others.		In fourth grade, students may construct arguments using concrete referents, such as objects, pictures, and drawings. They explain their thinking and make connections between models and equations. They refine their mathematical communication skills as they participate in mathematical discussions involving questions like “How did you get that?” and “Why is that true?” They explain their thinking to others and respond to others’ thinking.
4.MP.4. Model with mathematics.		Students experiment with representing problem situations in multiple ways including numbers, words (mathematical language), drawing pictures, using objects, making a chart, list, or graph, creating equations, etc. Students need opportunities to connect the different representations and explain the connections. They should be able to use all of these representations as needed. Fourth graders should evaluate their results in the context of the situation and reflect on whether the results make sense.
4.MP.5. Use appropriate tools strategically.		Fourth graders consider the available tools (including estimation) when solving a mathematical problem and decide when certain tools might be helpful. For instance, they may use graph paper or a number line to represent and compare decimals and protractors to measure angles. They use other measurement tools to understand the relative size of units within a system and express measurements given in larger units in terms of smaller units.

Reflection

How might these standards (content and mathematical practices) impact students? teachers? instruction?

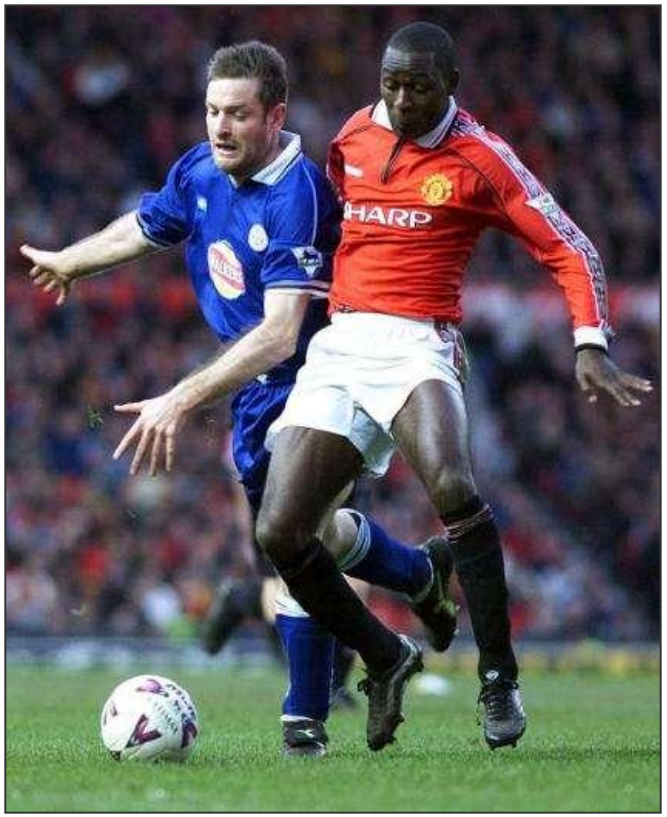
Rigor . . . . How does this impact students?

Rigor is not a measure of the quantity of content to be covered. Rather, *rigor is a measure of that content's quality*.

Sophistication of Knowledge

Students use the same basic skills but in a more sophisticated way.

Same rules, higher level game….



How might you determine the rigor of this standard?

4.OA.3. Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

Rigor . . . . How does this impact instruction?

"Rigor is the goal of helping students develop the capacity to understand content that is complex, ambiguous, provocative, and personally or emotionally challenging."

(*Teaching What Matters Most: Standards and Strategies for Raising Student Achievement*. ASCD, 2001)

Eight Mathematical Practices

Mathematical Practices:

- are always interrelated with content
- must be addressed in tandem
- may provide a way to observe classrooms to see how content is made understandable, challenging, and engaging to students

Agenda for Today

- Identify the advances and shifts in the 2010 Mathematics Standards
- Examine the architecture of the Mathematics Standards
- Identify rigor in the standards and classroom instruction

Questions?

K-12 Academic Standards

Mathematics Standards

Arizona Department of Education

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